Appendix J

Space Flight Operations Contract

Orbiter-In-A-Box
User Manual

Contract NAS9-20000

Orbiter-In-A-Box
User Manual

Prepared by

Bill Askew
USA/Advanced Technology (01-40500)

Approved by

Matt Barry
USA/Advanced Technology (01-40500)

Approved by

Susan Ahrens
USA/Advanced Technology (01-40500)

Contract NAS9-20000

REVISION HISTORY

DATE	VERSION	DESCRIPTION	AUTHOR
		Basic	Askew, Bill

Orbiter-In-A-Box
User Manual

LIST OF EFFECTIVE PAGES

The current status of all pages in this document is as shown below:

Page No.	Change No.
All	Basic

PREFACE

The Orbiter-In-A-Box User Manual was prepared by United Space Alliance (USA), Flight Operations.

The primary responsibility is with USA, Advanced Technology (01-40500).

Questions concerning the technical content of this document should be directed to Susan Ahrens, 281-282-3198, USH-405L, D/7010.

Contents

Section Page

Section Page

Figures

Section Page

Section **Page**

Tables

Section **Page**

1.0 INTRODUCTION

The Orbiter-In-A-Box (OIAB) User Manual describes the purpose and use of OIAB from a payload customer's viewpoint. This document is tutorial in nature to guide you through the application of the tool.

1.1 PURPOSE OF OIAB

OIAB uses actual flight software to test the Cargo Personal Computer (Cargo PC[SM]) application software against the General Purpose Computer (GPC) Payload Command Filter (GPCF) function to allow you to verify commands, fault annunciations, and telemetry acquisition for your payload. You can use the OIAB to test Shuttle Mission Simulator (SMS) payload training models that you build with the SMS Modeling Tool (SMT). Finally, you can use the OIAB to test the orbiter interface between the Cargo PC and your payload. You control and configure the OIAB from the Payload Operations Support Team (POST) Tools PC (PTPC).

OIAB runs two General Purpose Computer Emulators (GPCE), one emulator running the Space Shuttle orbiter's Guidance and Navigation Computer (GNC) major function, and the other running the orbiter's System Management (SM) major function. In addition, the OIAB runs an Internet web server, an Information Sharing Protocol (ISP) server, the SMS models, and some diagnostic, logging, reconfiguration, and monitoring tools. The OIAB enables development and testing of both actual and model payloads, with support for the orbiter Payload Data Interleaver (PDI), Pulse Code Modulation Master Unit (PCMMU), Payload Signal Processor (PSP) interfaces, and Payload Multiplexer/Demultiplexer (MDM) interfaces, which includes the MDM Serial Input/Output (SIO) interface to the Cargo PC and analog and discrete interfaces.

1.2 MINIMUM SYSTEM REQUIREMENTS

- PTPC

2.0 GETTING STARTED

OIAB uses web-based functionality to manage configuration and control functions. OIAB comes in a "lite" version, without support for flight hardware, and a "full-up" version, containing support for flight hardware.

2.1 INITIALIZING/STARTING THE OIAB

1. Connect a power supply to the OIAB enclosure and connect any external interface cables. If you are using the Cargo PC, install the Personal Computer Memory Card International Association (PCMCIA) communications card in any of the five PCMCIA slots.

2. Configure the Dual Inline Package (DIP) Switches on the front panel of the first Central Processing Unit (CPU) card. DIP Switches on the second processor card have no particular meaning.

Table 2-1. OIAB CPU DIP Switches

DIP Switch	Description
0	Specifies automatic load (RUN) or manual control (FREEZE) Left Position – OIAB boots with the GPCE and SMT tasks in RUN Right Position – OIAB boots with the GPCE or SMT tasks in FREEZE
1	Specifies if the OIAB will boot from a data store Left Position – OIAB boots from an on-orbit common set data store Right Position – OIAB boots into OPS 0 without a data store
2, 3, 4, 5, 6, 7	No particular meaning

3. You must connect cables for any external devices required for the session.

4. On the back of the OIAB enclosure, switch Power to ON.

5. OIAB starts the web server to provide the user interface. The web server provides page formats and content for user browsers.

6. OIAB conducts an inventory of the hardware components, performs a self test on CPU status on both CPUs, performs a Random Access Memory (RAM) check on the processor board, performs bite status reads on inventory-present cards, and then performs a hard disk check.

   Note: If OIAB is restarted from software or from the front panel DIP Switches, it skips the self-test.

7. OIAB loads and reads the front panel DIP Switches to determine the desired application configurations.

8. OIAB starts the platform services and application services, including peripheral drivers, various embedded servers, the GPCEs, and the SMS models. It will configure any installed external interface board drivers, and

the boards will be servicing their ports. Additionally, there will be live input/output ports on the external network interface.

9. After initialization, OIAB begins to run, and you can use the Multifunction Cathode Ray Tube (CRT) Display System (MCDS) emulator.

2.2 ACCESSING OIAB

1. Start Internet Explorer.
2. In the Address line, type the OIAB web address `http://<ipaddress>`.
3. In the OIAB Home page, access the web site through the navigation panel on the left side of the screen.

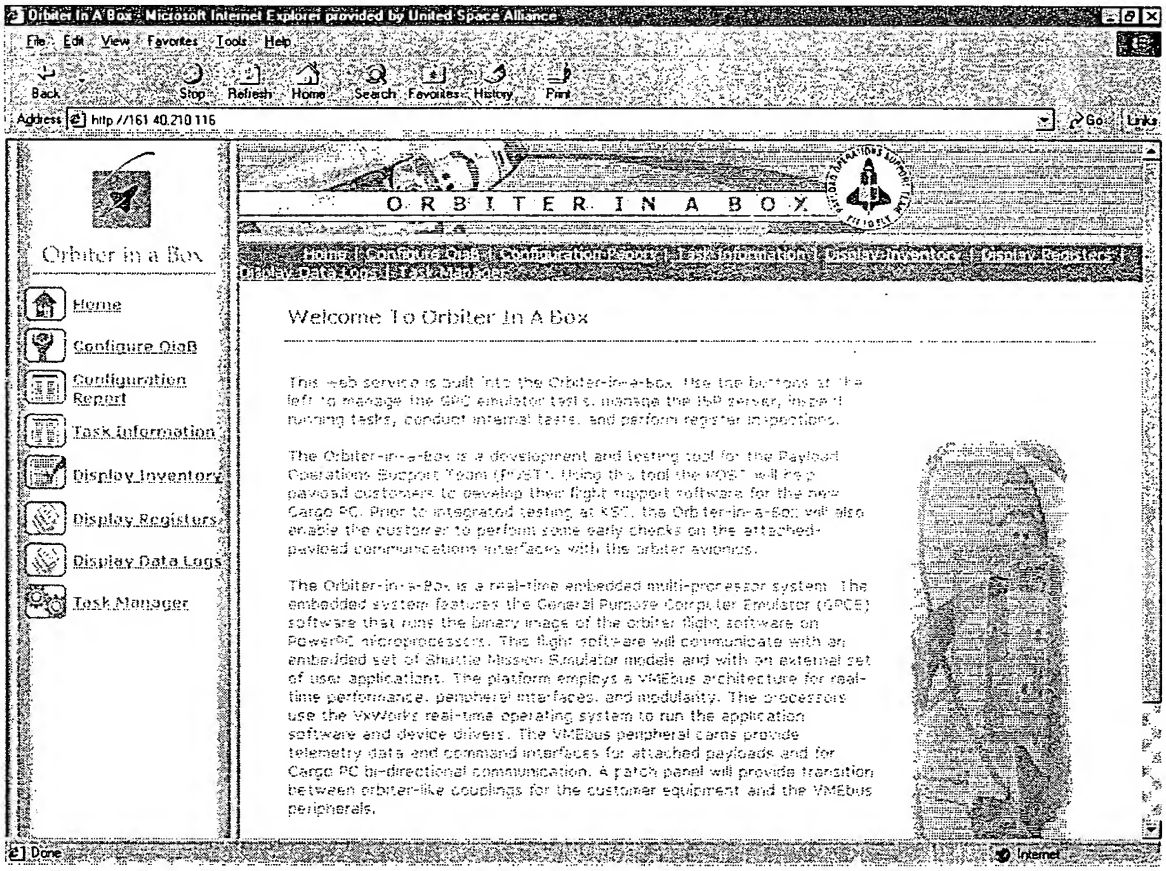

Figure 2-1. OIAB Home Page

3.0 OIAB HARDWARE

The available hardware components are the Single Board Computer (SBC), MDM Serial Interface Card (MIC), Small Computer System Interface (SCSI) Disk, PSP, PCMMU, PDI, Shared Common Random Access Memory Network™ (SCRAMNet), Truetime, MDM Analog Input Differential (AID), MDM Discrete Input High (DIH), MDM Discrete Input Low (DIL), MDM Discrete Output High (DOH), and an Ethernet Network Switch.

3.1 FULL-UP VERSION

The full-up version of OIAB has an Avionics Chassis, signal conditioning chassis, Standard Switch Panel (SSP), Standard Input Panel (SIP), Payload Data Interface Panel (PDIP), and a PCMMU panel.

3.2 LITE PLUS VERSION

The lite plus version of OIAB only has the Avionics Chassis.

3.3 LITE VERSION

The lite version of OIAB has the Avionics Chassis without the PDI, MDM analog-discrete, and PSP cards.

3.4 AVIONICS CHASSIS

3.4.1 Single Board Computer

The OIAB has one SBC, or CPU card, which is a Synergy VGM-5 Dual processor PowerPC™. Always the left-most board in the VME rack, the SBC is equipped with a set of eight DIP Switches on the front panel, where DIP Switch 0 is at the top, and DIP Switch 7 is at the bottom. Additionally, the SBC has two momentary switches that reset the OIAB when simultaneously depressed to the right.

Table 3-1. OIAB SBC DIP Switches

DIP Switch	Description
0	Specifies automatic load (RUN) or manual control (FREEZE) Left Position – OIAB boots with the GPCE and SMT tasks in RUN Right Position – OIAB boots with the GPCE or SMT tasks in FREEZE
3	Specifies Hardware or Software mode Left Position – OIAB starts in Hardware mode (ready to interface with the payload) Right Position – OIAB starts in Software mode

3.4.2 MIC Hardware Interface

The MIC connects payload MDM P701 to the MIC in the Cargo PC.

3.4.3 SCSI Disk

The SCSI disk contains all of the OIAB programs, web pages, and configuration files. This disk is connected to the SBC via a SCSI cable.

3.4.4 PSP Hardware Interface

When the OIAB is configured in Hardware mode (DIP switch 3), the PSP model uses a PCM Simulator card to connect to and communicate with the payload. The green light indicates the PSP interface is active.

3.4.5 PCMMU Hardware Interface

A PCM Simulator card connects the PCMMU model to the Cargo PC decommutation card. The illuminated light indicates that the PCMMU interface is active.

Table 3-2. PCMMU Interface Lights

Illumination Color	Data Light "On"	Data Light "Off"
Green	Updating data is output and the GPCE is running	N/A
Red	Static data is output	N/A
None	N/A	Nothing is output

3.4.6 PDI Hardware Interface

When the OIAB is configured in Hardware mode, the PDI model uses a bit synchronization and decommutation card to connect to and communicate with the payload.

Table 3-3. PDI Interface Lights

Light Indicator	Description	"On" Criteria (Green)	"Off" Criteria
Sig Pres	A signal is present on the BNC connector	N/A	• PDI is configured; valid data is received • PDI is configured or not; no data is received
Sig Lock	The card is locked on the BNC signal	N/A	• PDI is configured; valid data is received • PDI is configured or not; no data is received
FR	Minor frame lock	PDI is configured; valid data is received	PDI is configured or not; no data is received
FS	Major frame lock	PDI is configured; valid data is received	PDI is configured or not; no data is received
IRIG Lock	Lock on incoming IRIG time signal	N/A	• PDI is configured; valid data is received • PDI is configured or not; no data is received

3.4.7 Plug and Play Model Interface

When the OIAB is configured in software mode, the MDM, PDI, and PSP models will communicate with your Plug and Play (PnP) models (generated by the SMS Modeling Tool (SMT)) via the SCRAMNet reflective memory interface.

Table 3-4. PNP/SCRAMNet Interface Lights

Light Indicator	On when ...
Insert	SCRAMNet card is inserted into the network ring
Message Waiting	Message is placed in the transmit FIFO
Carrier Detect	Valid pair of transmit lights are received by this SCRAMNet card
Error	Error conditions are set in CSR1 register
Native Message	Message received was originated by this SCRAMNet card
Foreign Message	Message received was originated by another SCRAMNet card

3.4.8 System Timing and IRIG Data

A timing card provides OIAB system timing. The simulated Greenwich Mean Time (GMT) time is displayed on a Light Emitting Diode (LED) display. This feature is yet to be completed.

3.4.9 MDM, Discrete, and Analog Hardware Interfaces

When the OIAB is configured in hardware mode, the payload MDMs (PF01 and PF02) are connected to the payload using the hardware connector on the second OIAB unit.

3.4.10 Ethernet Network Switch

The Ethernet Network Switch allows you to connect the PTPC and OIAB when there is no other network available. You can create a standalone Local Area Network (LAN) by connecting the PTPC and the OIAB through this switch at any port. To connect this LAN to a facility network, use an uplink (crossover) cable between the OIAB switch and the facility switch. Any switch port will suffice.

3.5 OIAB PANELS

3.5.1 Standard Switch Panel

The "full-up" OIAB has a Space Shuttle Standard Switch Panel (SSP). The SSP provides switches for your payload. Each switch can be assigned to a specific aspect of the payload, if necessary. You wire both in-bound and out-bound signals. The OIAB does not drive any of the switches or talkbacks on this panel. Its purpose is to control/support some of the pins on the SIP hardware connector.

3.5.2 Standard Input Panel

The "full-up" OIAB has an SIP. This panel provides connectors J1 – J16 for your payload. Not all of these connectors are active.

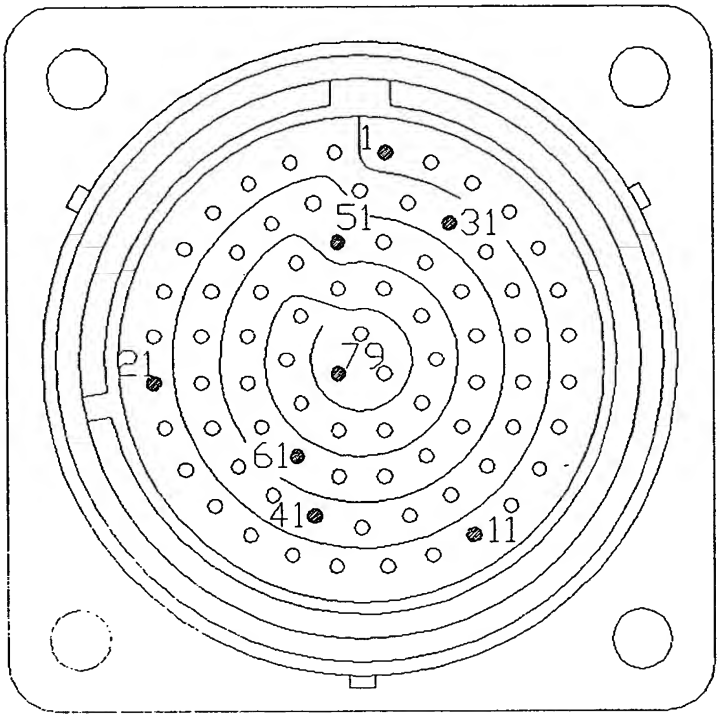

Figure 3-1. SIP Pin Layout

Table 3-5. PORT Connections

PIN	J103 (J13)	J107 (J12)	J108 (J11)
1	DOH 1 (OD04)	NC	NC
2	DOH 2 (OD05)	NC	NC
3	DOH 3 (OD06)	NC	NC
4	DOH 4 (OD07)	NC	NC
5	DOH 1-4 RTN (COM1)	NC	NC
6	NC	NC	NC
7	NC	NC	NC
8	NC	NC	NC
9	NC	NC	NC
10	NC	NC	DOL 1 (OD08)
11	NC	NC	DOL 2 (OD09)
12	NC	NC	DOL 3 (OD10)
13	SSP - S13	NC	DOL 4 (OD11)
14	SSP - S13	NC	DOL 1-4 RTN (COM1)
15	NC	NC	NC

PIN	J103 (J13)	J107 (J12)	J108 (J11)
16	SSP - S13	NC	DOL 5 (OD12)
17	SSP - S13	NC	DOL 6 (OD13)
18	NC	NC	DOL 7 (OD14)
19	SSP - S13	NC	DOL 8 (OD15)
20	SSP - S13	NC	DOL 5-8 RTN (COM1)
21	NC	NC	NC
22	SSP - S14	NC	DIL 1 (IN08)
23	SSP - S14	NC	DIL 2 (IN09)
24	NC	NC	DIL 3 (IN10)
25	SSP - S14	NC	DIL 4 (IN11)
26	SSP - S14	NC	DIL 1-4 RTN (COM1)
27	NC	NC	NC
28	SSP - S20	NC	DIL 5 (IN12)
29	SSP - S20	NC	DIL 6 (IN13)
30	NC	NC	DIL 7 (IN14)
31	SSP - S23	NC	DIL 8 (IN15)
32	SSP - S23	NC	DIL 5-8 RTN (COM1)
33	NC	NC	NC
34	SSP - S24	NC	AID 1
35	SSP - S24	NC	AID 1 RTN
36	NC	NC	NC
37	SSP - S24	NC	AID 2
38	SSP - S24	NC	AID 2 RTN
39	NC	NC	NC
40	SSP - S21	NC	SSP - DS124
41	SSP - S21	NC	SSP - DS24 RTN
42	NC	NC	NC
43	SSP - S19	NC	SSP - DS123
44	SSP - S19	NC	SSP - DS23 RTN
45	NC	NC	NC
46	SSP - S15	NC	SSP - DS22
47	SSP - S15	NC	SSP - DS22 RTN
48	NC	NC	NC
49	SSP - S16	NC	SSP - DS21
50	SSP - S16	NC	SSP - DS21 RTN
51	NC	NC	NC
52	SSP - S16	NC	SSP - DS20
53	SSP - S16	NC	SSP - DS20 RTN
54	NC	NC	NC
55	CB 4	NC	SSP - DS19
56	CB4 RTN	NC	SSP - DS19 RTN
57	NC	NC	NC

PIN	J103 (J13)	J107 (J12)	J108 (J11)
58	SSP - S18	PDI IN +	SSP - DS18
59	SSP - S18	PDI IN -	SSP - DS18 RTN
60	NC	NC	NC
61	SSP - S15	PDI CLK +	SSP - DS17
62	SSP - S15	PDI CLK -	SSP - DS17 RTN
63	NC	NC	NC
64	SSP - S18	PSP	SSP - DS16
65	SSP - S18	PSP RTN	SSP - DS16 RTN
66	NC	NC	NC
67	SSP - S21	NC	SSP - DS15
68	SSP - S21	NC	SSP - DS15 RTN
69	NC	NC	NC
70	SSP - S17	NC	SSP - DS14 RTN
71	SSP - S17	NC	SSP - DS14
72	NC	NC	NC
73	SSP - S22	NC	SSP - DS13
74	SSP - S22	NC	SSP - DS14
75	NC	NC	NC
76	SSP - S16	NC	SSP - DS13
77	28V RTN	NC	SSP - DS13 RTN
78	NC	NC	NC
79	NC	NC	NC

Table 3-6. Starboard Connections

PIN	J103 (J16)	J107 (J15)	J108 (J14)
1	DOH 1 (OD00)	NC	NC
2	DOH 2 (OD01)	NC	NC
3	DOH 3 (OD02)	NC	NC
4	DOH 4 (OD03)	NC	NC
5	DOH 1-4 RTN (COM 1)	NC	NC
6	NC	NC	NC
7	NC	NC	NC
8	NC	NC	NC
9	NC	NC	NC
10	NC	NC	DOL 1 (OD00)
11	NC	NC	DOL 2 (OD01)
12	NC	NC	DOL 3 (OD02)
13	SSP - S1	NC	DOL 4 (OD03)
14	SSP - S1	NC	DOL 1-4 RTN (COM0)
15	NC	NC	NC
16	SSP - S1	NC	DOL 5 (OD04)
17	SSP - S1	NC	DOL 6 (OD05)

PIN	J103 (J16)	J107 (J15)	J108 (J14)
18	NC	NC	DOL 7 (OD06)
19	SSP - S1	NC	DOL 8 (OD07)
20	SSP - S1	NC	DOL 5-8 RTN (COM0)
21	NC	NC	NC
22	SSP - S2	NC	DIL 1 (IN00)
23	SSP - S2	NC	DIL 2 (IN01)
24	NC	NC	DIL 3 (IN02)
25	SSP - S2	NC	DIL 4 (IN03)
26	SSP - S2	NC	DIL 1-4 RTN (COM0)
27	NC	NC	NC
28	SSP - S8	NC	DIL 5 (IN04)
29	SSP - S8	NC	DIL 6 (IN05)
30	NC	NC	DIL 7 (IN06)
31	SSP - S11	NC	DIL 8 (IN07)
32	SSP - S11	NC	DIL 5-8 RTN (COM0)
33	NC	NC	NC
34	SSP - S12	NC	AID 1
35	SSP - S12	NC	AID 1 RTN
36	NC	NC	NC
37	SSP - S12	NC	AID 2
38	SSP - S12	NC	AID 2 RTN
39	NC	NC	NC
40	SSP - S9	NC	SSP - DS12
41	SSP - S9	NC	SSP - DS12 RTN
42	NC	NC	NC
43	SSP - S7	NC	SSP - DS11
44	SSP - S7	NC	SSP - DS11 RTN
45	NC	NC	NC
46	SSP - S3	NC	SSP - DS10
47	SSP - S3	NC	SSP - DS10 RTN
48	NC	NC	NC
49	SSP - S4	NC	SSP - DS9
50	SSP - S4	NC	SSP - DS9 RTN
51	NC	NC	NC
52	SSP - S4	NC	SSP - DS8
53	SSP - S4	NC	SSP - DS8 RTN
54	NC	NC	NC
55	CB 2	NC	SSP - DS7
56	CB2 RTN	NC	SSP - DS7 RTN
57	NC	NC	NC
58	SSP - S6	PDI IN +	SSP - DS6
59	SSP - S6	PDI IN -	SSP - DS6 RTN

PIN	J103 (J16)	J107 (J15)	J108 (J14)
60	NC	NC	NC
61	SSP - S3	PDI CLK +	SSP - DS5
62	SSP - S3	PDI CLK -	SSP - DS5 RTN
63	NC	NC	NC
64	SSP - S6	PSP	SSP - DS4
65	SSP - S6	PSP RTN	SSP - DS4 RTN
66	NC	NC	NC
67	SSP - S9	NC	SSP - DS3
68	SSP - S9	NC	SSP - DS3 RTN
69	NC	NC	NC
70	SSP - S5	NC	SSP - DS2 RTN
71	SSP - S5	NC	SSP - DS2
72	NC	NC	NC
73	SSP - S10	NC	SSP - DS1
74	SSP - S10	NC	SSP - DS14
75	NC	NC	NC
76	SSP - S4	NC	SSP - DS1
77	28V RTN	NC	SSP - DS1 RTN
78	NC	NC	NC
79	NC	NC	NC

3.5.3 Payload Data Interface Panel (PDIP)

This panel provides the MDM SIO connector for the Cargo PC.

3.5.4 PCMMU Panel

This panel provides the PCMMU connector for the Cargo PC.

4.0 USING OIAB

OIAB features a web interface from which you can perform and monitor various OIAB tasks, such as manage GPCE tasks, manage the ISP server, inspect running tasks, perform register inspections, and test the OIAB and the OIAB components.

4.1 CONFIGURE OIAB

If the OIAB has never been specifically configured for your payload, the OIAB Host Configuration login is displayed. The PTPC and OIAB Internet Protocol (IP) addresses must be set before making any configurations. If the OIAB has been configured at least once, the Configure Orbiter-In-A-Box web site is displayed.

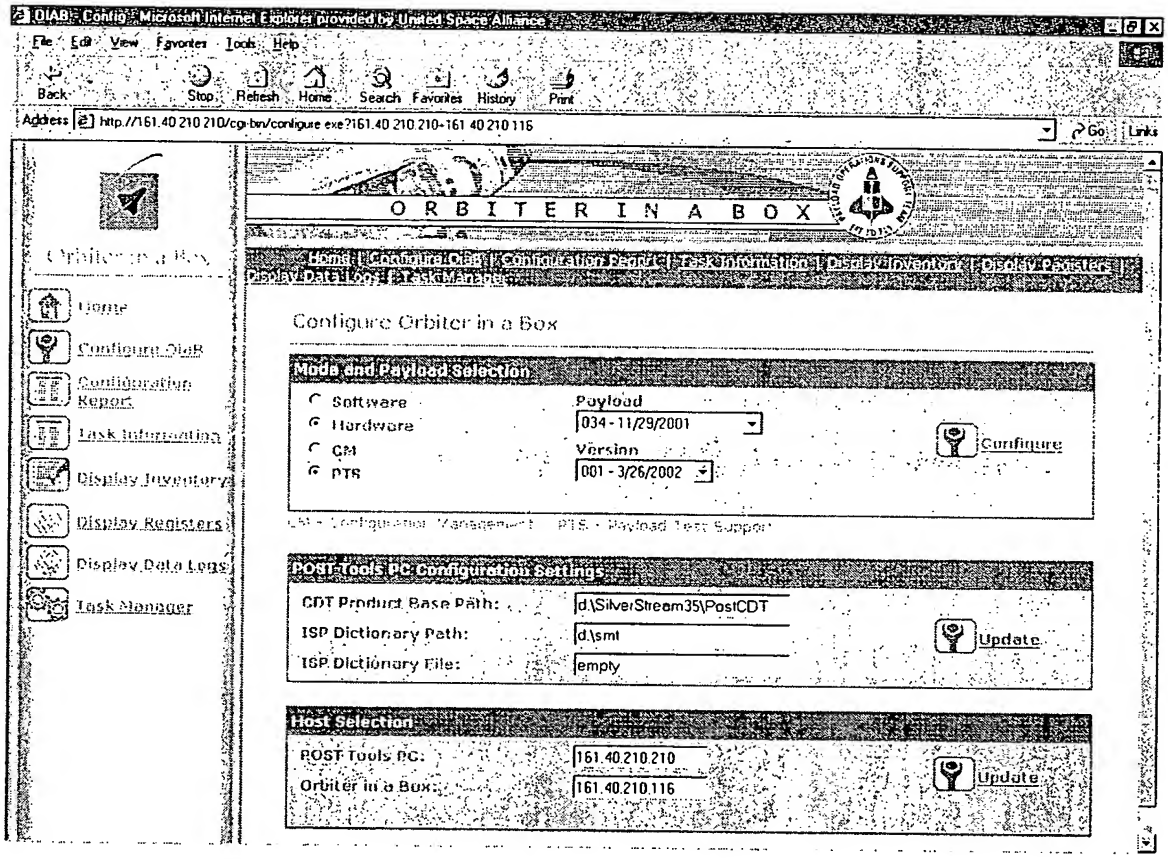

Figure 4-1. Configure OIAB

4.1.1 Mode and Payload Selection

1. On the OIAB web site navigation pane, click Configure OIAB.
2. In the Mode and Payload Selection panel, choose Hardware or Software.
3. Choose Configuration Management (CM) or Payload Test Support (PTS).
4. Select the Payload.

5. Select the Version.
6. Click Configure to generate the required OIAB configuration files.

4.1.2 POST Tools PC Configuration Settings

1. On the OIAB web site's navigation pane, click Configure OIAB.
2. In the POST Tools PC Configuration Settings panel, type the CDT Product Base Path.
3. Type the ISP Dictionary Path.
4. Type the ISP Dictionary File.
5. Click Update to update the configuration settings.

4.1.3 Host Selection

1. On the OIAB web site's navigation pane, click Configure OIAB.
2. In the Host Selection panel, type the POST Tools PC IP address.
3. Type the Orbiter In A Box IP address.
4. Click Update to update the configuration settings.

4.2 CONFIGURATION REPORT

Table 4-1. Configuration Report

Release Information	
Release	Release information about OIAB
Build	Build information about OIAB
OI Image	Flight software version
OIAB X Boot Configuration	
Parameter	Non-volatile RAM parameter on the X processor
Value	Non-volatile RAM parameter value on the X processor
OIAB Y Boot Configuration	
Parameter	Non-volatile RAM parameter on the Y processor
Value	Non-volatile RAM parameter value on the Y processor
ISP Server Configuration	
IP Address	IP address for the ISP server
Port Number	TCP/IP port number
DEU (MCDS) Server Configuration	
IP Address	IP address for the DEU server
Port Numb r	TCP/IP port number

Hardware Inventory	
Hardware Component	Lists the hardware component
In Inventory	Specifies whether the hardware component is in the Avionics Chassis
Status	The self-test ran for the respective hardware and if it passed or failed
MDM Configuration	
MSID	The term's Measurement Stimulus Identification (MSID) or Customer ID
Card Type	The term's Bus Terminal Unit (BTU) card type
Card Location	The term's BTU card location and number
Channel Number	The term's BTU channel number
Start Bit	The term's start bit within the data word
Data Length	The term's number of data bits
PDI via ISP Configuration	
MSID	The term's MSID or customer ID
Card Type	Data type; options are AMB, AMU, BCD, BCH, BD, etc.
Number of DFLs	Number of Decom Format Loads (DFL) the term is in
Start Bit	The term's start bit within the data word
Data Length	The term's number of data bits
Customer PSP Command Configuration	
MSID	The term's MSID or customer ID
UMB	Umbilical number
# Cmd Words	Number of command words
Command Words	'...' separated list of command words
Customer DFL Configuration	
Fmt ID	DFL ID
Fmt Mode	1 – 7 describes telemetry structure; 1 – 4 supported
Wrds Per Frm	Number of data words per frame
Frms Mjr Frm	Number of frames per major frame
Mjr Frm Prd	Period of time required to receive a major frame
Bit Rate	Number of bits transmitted/received per second
Mnr Frm Sync	Sync pattern used to locate minor frames
Mnr Sync FL	Sync pattern in First (F) or Last (L) words in frame (minor)
Mnr Sync SW#	Word number in frame containing sync pattern
Mjr Frm Sync	Sync pattern used to locate major frames
Mjr Sync FL	Sync pattern in First or Last words in major frame
Mjr Sync SW#	Word number in major frame containing sync pattern
Mnr Cnt UD	Mode 3 only; minor frame counter counts Up (U) or Down (D)
Mnr Cnt Init	Mode 3 only; minor frame counter initial value
Mnr Cnt Wrd#	Mode 3 only; word in frame containing frame counter
Samp Rate #1	First of possibly many sample rates for DFL
Configuration Error Log	
Reports any detectable errors in the OIAB configuration	

4.3 TASK INFORMATION

The Task Information page lists all the tasks and/or programs that are running the OIAB hardware.

Table 4-2. Task Information

Column Name	Description
NAME	Name of the task
ENTRY	Entry point; function name
TID	Task ID
PRI	Priority; 0 to 255, where 0 is the highest priority; if the task is not assigned a priority in the code, is starts at 100
STATUS	Ready – Task is not waiting for any other resource other than the CPU Pend – Task is blocked due to the unavailability of some resource Delay – Task is asleep for some duration Suspend – Task can't be executed (not suspended, delayed, or pending) Delay+S – Task is delayed and suspended Pend+S – Task is pending and suspended Pend+T – Task is pending with a timeout Pend+S+T – tasking is pending and suspended with a timeout ...+I – Task has inherited priority (+I may be appended to any string above) Dead – Task no longer exists
SP	Hexadecimal stack pointer value that indicates where in the RAM the program memory begins/resides
ERRNO	Hexadecimal error number assigned to that task
DELAY	Task has been delayed by this number of ticks

4.4 DISPLAY INVENTORY

Display Inventory lists all hardware components available in the Avionics Chassis, their current status on the chassis, and whether they have been tested. The available hardware components are CPU, SCSI Disk, MDM AID, MDM DIH, MDM DIL, MDM DOH, Network Switch, PCMMU, PDI, PMC871, PSP, SCRAMNet, SIO MIC Device in PMC, and Truetime.

Note: This page is not valid until the system has performed the inventory.

Table 4-3. Display Inventory

Column Name	Description
Message	All hardware components that can be available in the Avionics Chassis
Present	The respective hardware exists in the Avionics Chassis
Status	The self-test ran for the respective hardware and if it passed or failed

4.5 DISPLAY REGISTERS

The Display Registers web page displays the register contents of each existing hardware component in the Avionics Chassis.

Table 4-4. Display Registers

Column Name	Description
Register Number	Identifying number of register
Register Name	Name of register
Register Value	Value stored in register
Register Address	Location of register

4.6 DISPLAY DATA LOGS

The Display Data Logs web page displays data log files generated by the PCMMU, PDI, PSP, and MIC SIO device independents. To view a file, click the corresponding link in the Data Log Selection panel.

4.7 TASK MANAGER

The Task Manager's primary functions include system management, GPCE management, ISP management, and testing. The OIAB automatically performs a self-test upon booting. This self-test saves the results for each hardware component in the Inventory.

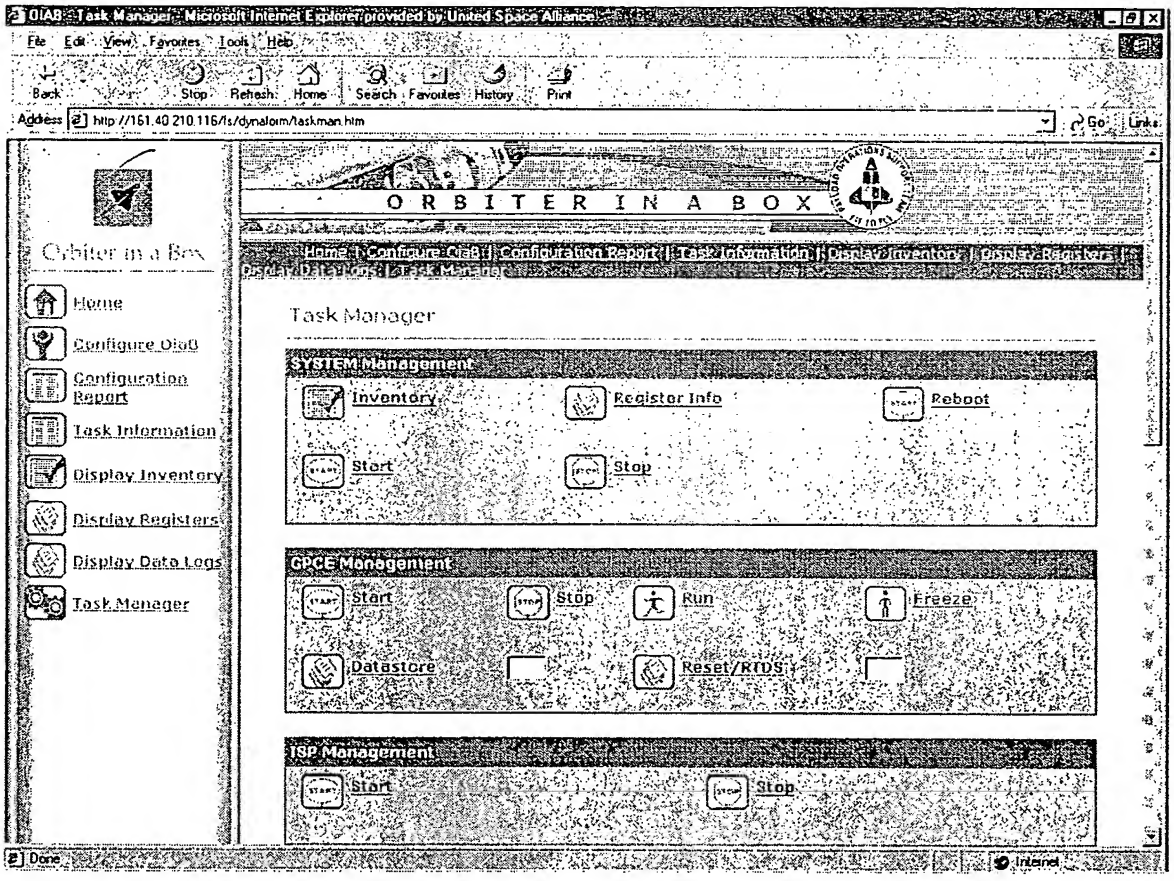

Figure 4-2. Task Manager

Table 4-5. System Management Panel

Command	Description
Inventory	Runs the inventory cards installed on the systems, which can be seen in the Display Inventory page
Register Info	Displays crucial data register information in the OIAB
Reboot	Reboots the OIAB
Start	Starts the GPC emulator
Stop	Stops the GPC emulator

Table 4-6. GPCE Management Panel

Command	Description
Start	Starts the GPC emulator
Stop	Stops the GPC emulator
Run	Runs the simulation
Freeze	Pauses the simulation if it is running
Datastore	Assign to a datastore (a snapshot of the MCDS configuration)
Reset/RTDS	Type a previously assigned datastore number to reset the MCDS configuration

Table 4-7. ISP Management Panel

Command	Description
Start	Starts the ISP server
Stop	Stops the ISP server

4.7.1 Test Panels

In the Test panels, you can run self-tests and diagnostics on the different hardware components in the Avionics Chassis. You cannot test any hardware components when you have started System Management, GPCE Management, or ISP Management, unless the OIAB is in the idle state. Once the OIAB is turned on and running, you can perform any other tests.

Table 4-8. Test Panels

Testing Option	Description
Self Test	Tests if the component is existing; performs a self test on the respective hardware component; available for all hardware component testing
Dynamic Self Test	Tests if the component is existing and executes a predefined task on the component; returns results
Start Data Log	Starts the data log; available only for PCMMU, PDI, PSP, and SIO MIC
Stop Data Log	Stops the data log; available only for PCMMU, PDI, PSP, and SIO MIC

5.0 MULTIFUNCTION CRT DISPLAY SYSTEM EMULATOR

The MCDS is part of the Space Shuttle on-board Data Processing System hardware. On the orbiter, the MCDS is part of the flight crew station. The MCDS emulator allows you to communicate with the GPCE through the OIAB via five Transmission Control Protocol (TCP)/IP sockets. The MCDS emulator renders Space Shuttle cockpit displays, interprets cockpit keyboard entries, provides certain controllable cockpit panel devices, and creates malfunctions for testing scenarios. The primary functions of the MCDS emulator are:

a. Emulation of the MCDS Display Electronics Units (DEU)

b. Simulation of the keyboards

c. Simulation of the CRTs

d. Simulation of the relevant cockpit switches

e. User interface to the Primary Avionics Software System (PASS) running on the GPCEs inside the OIAB

5.1 MCDS EMULATOR DESKTOP

The MCDS emulator Graphical User Interface (GUI) desktop resembles the layout of the orbiter cockpit forward and aft stations. It also includes a history feature, recording keystrokes and switch throws.

Table 5-1. File Menu

Menu Option	Description
About	Displays a program description
Exit	Closes the MCDS emulator

Table 5-2. Controls Menu

Menu Option	Description
Socket	Opens the Connection Manager to specify and control the TCP/IP network socket connections with the GPCE
Layout Desktop	Repositions the windows on the Fore Station, Aft Station, or History desktops to their default positions
Reset Switches	Moves all of the panel switches back to their initial positions
Macro Recorder	Records and plays preserved keystroke and switch throw patterns
Flashing	Allows you to specify if the CRTs should flash objects on screen, since some objects on the CRTs are set in the flight software to flash on screen
Auto Focus	Allows you to manually type into the CRT frames without having to use the CDR or PLT Keyboards; when selected, the mouse pointer will change to the crosshair cursor if floating over a CRT frame
Malfunctions	Allows you to change the behavior of Keyboard keys and panel switches by applying malfunctions to them

5.1.1 Socket

The Socket option in the Controls menu opens the Connection Manager window, which allows you to specify the socket connection Host Name and Port Number, as well as the capability to Connect to or Disconnect from the five sockets. Sockets change color to indicate status as connected, disconnected, or unknown connection. If sockets close, the CRTs will show POLL FAIL (polling timeout) and display a big X (stale data). Status icons in the top-left corner of the CRT and panel windows will change color to reflect status.

1. In the Controls menu, click Socket.
2. In the Connection Manager, enter the Host Name and Port Number.
3. Click Connect to establish five socket connections on consecutive port numbers, starting with the number specified as the Port Number.
4. Click a socket to view its dialog indicating the last error or exception message received on that socket.

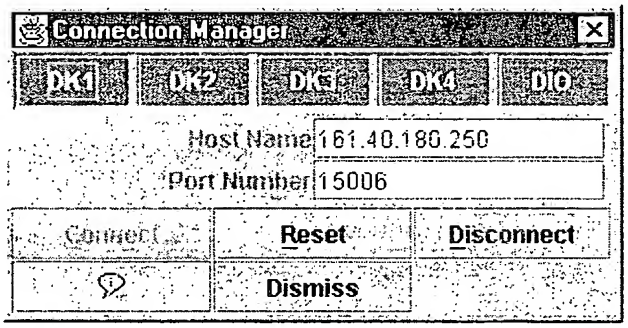

Figure 5-1. Connection Manager

Table 5-3. Sockets

Component	Description
DK1, DK2, DK3, DK4	Represent the DEU controller as the orbiter's four display-keyboard busses
DIO	Socket used for the discrete controller module to provide status information among the simulation components
Host Name	GPCE host name that is supported by the MCDS emulator proxy task
Port Number	Must be an integer
Connect	Connects the selected socket; connected socket buttons are green; unknown connection is gray
Reset	Clears the Host Name and Port Number fields
Disconnect	Disconnects sockets; disconnected socket buttons are red; unknown connection is gray; Disconnect is disabled if there is no connection
About	(Also an icon, depending on the platform)
Dismiss	Closes the Connection Manager

5.1.2 Switches

The MCDS emulator switches represent those on the orbiter cockpit panels and provide input to the flight software. Before connecting to the GPCE, the MCDS emulator sets the default switch position configuration of the following:

- All DEU power switches ON.
- All major functions switches in GNC.
- All MDM power switches ON.
- The left CRT select switch to CRT 1.
- The right CRT select switch to CRT 2.
- GPC 1-4 power switches ON; GPC 5 power switch to OFF.
- GPC 1-4 output to NORMAL; GPC 5 output to TERMINATE.
- GPC 1-4 mode to RUN; GPC 5 mode to HALT.
- IPL source select to OFF.
- BFC CRT select 3-1; BFC CRT display OFF.
- OI PCMMU power to 1.

Note: After connecting, the GPCE sends its preference for the start-up switch configuration to the MCDS. The GPCE preferences depend on the state of the running simulation. The MCDS emulator will automatically reconfigure its switches to reflect this preferred state. Thereafter, any switch throws will affect the flight software or models as necessary.

5.2 MACRO RECORDER

The Macro Recorder allows you to preserve keystroke and switch throw patterns to be replayed later. With its VCR-like interface, the Macro Recorder features user-friendly controls to create instructions for MCDS emulator functions. You can run multiple Macro Recorder windows simultaneously. The Macro Recorder's menus are disabled when playing or recording an instruction list. The MCDS emulator stores the instructions in text files, where you can manually edit the macro.

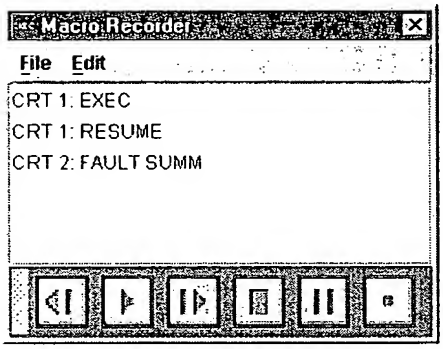

Figure 5-2. Macro Recorder

Table 5-4. Macro Recorder Menus

Menu	Description
File	New – Starts a new Macro Recorder session
	Open – Opens an existing instruction list
	Save – Saves an instruction list
	Save As – Saves an instruction list as a new file name
	Close – Closes the Macro Recorder
	Recent – Recalls the most recent files used
Edit	Cut – Cuts selected text in an instruction list; Cut and Paste between instruction lists
	Copy – Copies selected text in an instruction list; Copy and Paste between instruction lists
	Paste – Pastes text at the cursor point in an instruction list
	Delay – Enter a time delay in milliseconds into the instruction sequence

Table 5-5. Macro Recorder Buttons

Button	Button	Description
Rewind		Returns to the beginning of instruction list
Play		Activates instruction at the current point in the instruction list
Forward		Advances to the end of the instruction list
Stop		Ends Play or Recording and returns to the beginning of the instruction list
Pause		Suspends Play or Record at the current point of play or recording
Record		Preserves keystroke and switch throw patterns in the MCDS emulator desktop

5.2.1 Record

During Record, the Macro Recorder preserves the Scratch Pad Line entries (keystrokes) and panel switch throws as instructions in the macro instruction list. The Macro Recorder logs only the Scratch Pad Line entries that you "commit" as commands to the GPCE. New keystrokes and switch throws are appended to the end of the current instruction list. To insert new instructions in the middle of an existing list, use the Cut/Copy and Paste options in the Edit menu.

5.2.2 Recording with the Macro Recorder

1. In the Controls menu, click Macro Recorder.
2. In the Macro Recorder window File menu, click New to open a new dialog.
3. In the Macro Recorder, click Record.
4. In the MCDS emulator desktop, use your mouse to create the keystroke and switch throw pattern to be recorded. The MCDS emulator records this pattern.
5. In the Macro Recorder, click Stop.
6. In the Macro Recorder, click Save.
7. To load the instructions, click Play.

5.2.3 Play

During Play, the MCDS emulator starts to play the first selected line of an instruction list or at the beginning of the file if no line is selected. When Play is in progress, the Play button displays a green arrow, the Macro Recorder's menus are disabled, and the list item activity is indicated in red.

The Macro Recorder assumes that the initial conditions (flight software state and switch positions) are appropriate for the instructions. The only exception to this statement is that the Macro Recorder will move the CDR or PLT Panel C2 CRT SELECT switches if necessary to communicate with one of the Fore Station CRTs.

5.2.3.1 Playing the Macro Recorder

1. In the Controls menu, click Macro Recorder.
2. In the Macro Recorder File menu, click Open.
3. In the Select dialog, select an existing instruction list. Click OK.
4. In the Macro Recorder, click Play to load the instructions.
5. In the Macro Recorder, click Stop to end Play.

5.2.3.2 Adjusting Play Pace

If the Macro Recorder advances faster than the flight software, you may need to adjust the pace of playing instructions.

- To adjust the Play duration between instructions, change the value of the `macro.sleep.line` property. The default value is 2000 milliseconds.
- To adjust the Play duration between keystrokes, change the value of the `macro.sleep.key` property. The default value is 300 milliseconds.

5.2.3.3 Delaying Play

1. In the Controls menu, click Macro Recorder.
2. In the Macro Recorder File menu, click Open.
3. In the Select dialog, select an existing instruction list. Click OK.
4. In the instruction list, place the cursor in the location where you want to delay play.
5. In the Edit menu, click Delay to specify a time delay in milliseconds into the instruction sequence.
6. In the Macro Recorder, click Play to load the instructions. When the Macro Recorder encounters a Delay instruction during Play, Play will pause for the specified duration.

5.2.3.4 Editing Macro Instruction Lists

1. In the Controls menu, click Macro Recorder.
2. In the Macro Recorder File menu, click Open.
3. In the Select dialog, select an existing instruction list. Click OK.
4. In the instruction list, select the text you want to modify.
5. In the Edit menu, click Cut or Copy.
6. Open a separate existing instruction list and place the cursor in the location where you want the cut/copied text to be inserted.
7. In the Edit menu, click Paste.

5.2.4 Malfunctions

The MCDS is sometimes used in training scenarios, where the MCDS simulates malfunctions that force you to work through the problem. In the MCDS emulator, you can introduce malfunctions, or the GPCE can issue malfunction commands from its connection. Malfunctions are available only if the Java property malfunctions have the value set to True.

1. In the Controls menu, click Malfunctions.
2. To introduce a malfunction, select a component on the MCDS emulator desktop.
3. In the selected component's right-mouse menu, view the current malfunction state values.
   (a) Observed – Reflects what you see (such as a switch in the middle position)
   (b) Functional – Reflects the simulation (such as a switch in the contact failed closed)

Table 5-6. Malfunction Descriptions

Malfunction	Description
Contact Failed Open	When a contact fails open, the switch bar cannot create continuity across the contact pair. Consequently, although the switch is apparently in the desired position, the contacts do not mate, and the desired functionality is not achieved.
Contact Failed Closed	When a switch contact fails closed, the switch bar is irrelevant and there is always electrical continuity across the contact pair. Consequently, although the switch is apparently in the desired position, the contacts mate at some other position, and the desired functionality may not be achieved. Sometimes a contact can fail closed behind the observed switch position, lurking behind the scene until you move the switch and an unexpected result occurs.
Frozen in Position	When panel switches are frozen, they are no longer movable from that position to any other position. This is a mechanical failure of the switch.
Failed Off	Individual keyboard keys will not respond when depressed; the Panel O1 lamps will not illuminate when commanded on
Failed On	Panel O1 lamps are illuminated constantly even when commanded off

Note: Panel switches can be frozen in the selected position. Panel switches have a pair of electrical contacts at each position (sometimes they have many pairs, but simulation does not differentiate).

5.3 FORE STATION

The Fore Station tab represents the displays and controls available to the Commander (CDR) and Pilot (PLT) at the front of the orbiter flight deck. This tab includes the three CRTs (CRT 1, CRT 2, and CRT 3), CDR, and PLT keyboards, Console (C) panels, Forward (F) panels, and Overhead (O) panels related to these devices. You can resize each CRT. You cannot resize the Keyboards or Panels.

5.3.1 Panel C2

Panel C2 is on the Fore Station desktop and contains the CRT Select switches for the CDR and PLT Keyboards. It also contains the MAJ FUNC (Major Function) switches and DEU Power switches for DEUs 1, 2, and 3. A crewmember would use this panel to select a CRT on which to enter information and instructions because the target CRT for keystroke entries depends on the position of Panel C2 CRT Select switches. To move a switch, simply click the mouse near the desired position. In the orbiter cockpit, Panel C2 is located between the CDR Keyboard and the PLT Keyboard. Click the top right corner of the panel to close. Click the desired position of the switch to move up, down, or center.

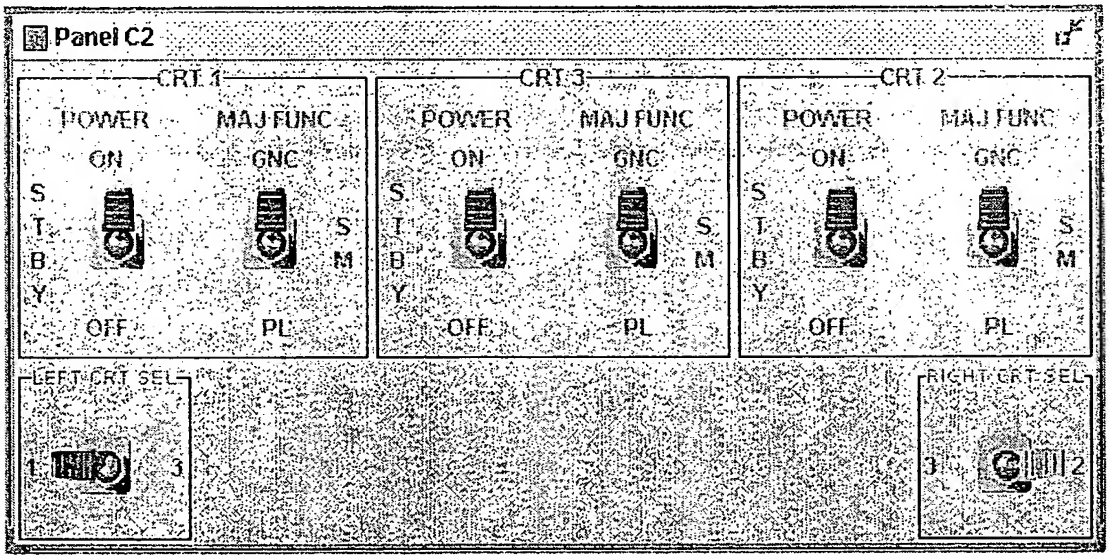

Figure 5-3. Panel C2

Table 5-7. Panel C2

Switch	Descripti n
CRT 1	
POWER	STBY – (Standby) CRT1 goes blank; displays a fictional status word ON – Refreshes CRT1 with the latest information from the GPCE OFF – CRT1 goes blank; displays a fictional status word
MAJ FUNC	GNC – (Guidance and Navigation Computer) Sets DEU status buffer bits for the GNC to enable flight software to send a different MAJ FUNC output to each DEU STBY – CRT1 goes blank; displays a fictional status word PL – (Payload) Sets DEU status buffer bits for the payload, which enables the flight software to send a different MAJ FUNC output to each DEU
CRT 3	
POWER	STBY – CRT3 goes blank; displays a fictional status word ON – Refreshes CRT3 with the latest information from the GPCE OFF – CRT3 goes blank; displays a fictional status word
MAJ FUNC	GNC – Sets DEU status buffer bits to enable flight software to send a different MAJ FUNC output to each DEU STBY – CRT3 goes blank; displays a fictional status word PL – Sets DEU status buffer bits, which enables the flight software to send a different MAJ FUNC output to each DEU
CRT 2	
POWER	STBY – CRT2 goes blank; displays a fictional status word ON – Refreshes CRT2 with the latest information from the GPCE OFF – CRT2 goes blank; displays a fictional status word
MAJ FUNC	GNC – Sets DEU status buffer bits to enable flight software to send a different MAJ FUNC output to each DEU STBY – CRT2 goes blank; displays a fictional status word PL – Sets DEU status buffer bits, which enables the flight software to send a different MAJ FUNC output to each DEU
LEFT CRT SEL	1 – CDR Keyboard will control CRT1 3 – CDR Keyboard will control CRT3
RIGHT CRT SEL	3 – PLT Keyboard will control CRT3 2 – PLT Keyboard will control CRT2

5.3.2 Panel C3

Panel C3 is on the Fore Station desktop and contains the Backup Flight Controller (BFC) CRT switches and the OI PCMMU switches. In the orbiter cockpit, Panel C3 is located under the CDR Keyboard. Click the top right corner of the panel to close. Click the switch up, down, or center to obtain the desired position.

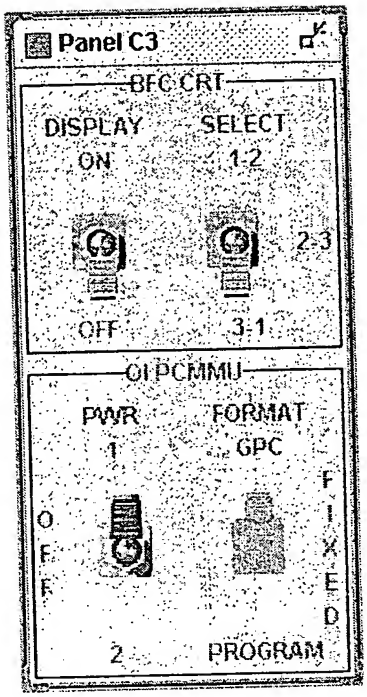

Figure 5-4. Panel C3

Table 5-8. Panel C3

Switch	Description
BFC CRT	
DISPLAY	ON – Specifies which CRTs are driven by BFS OFF – No CRTs will be driven by BFS
SELECT	1-2 – CRT1 and CRT2 are controlled by the DISPLAY switch 2-3 – CRT2 and CRT3 are controlled by the DISPLAY switch; CRT3 will receive the BFS content pre-engage 3-1 – CRT3 and CRT1 are controlled by the DISPLAY switch; CRT3 will receive the BFS content pre-engage; if ON it is only for ascent and entry
OI PCMMU	
PWR (Power)	1 – Power for PCMMU 1 OFF – No power for PCMMU 1 or 2 (disabled) 2 – Power for PCMMU 2 (disabled)
FORMAT	(Disabled) To change this disabled setting, use the "soft" entries in SPEC 62 to select the data format memory of FIXED or PROGRAM GPC – Determines whether FIXED or PROGRAM format memory is downlinked because only one is used at a time to generate telemetry output; moving the switch from GPC overrides the software selection FIXED – Hard telemetry data format memory (128 kbps) that is fusible link Programmable Read-Only Memory (PROM) PROGRAM – Telemetry data format memory (64 kbps) of random access memory (RAM) that is programmable in-flight by the SM computer

5.3.3 Panel F6

Panel F6 is on the Fore Station desktop and contains the BFC disengage switch. The BFC disengage switch is a momentary switch to disengage (down) the backup flight controller after an engage. This switch is not used to configure OIAB. Click the top right corner of the panel to close.

Figure 5-5. Panel F6

5.3.4 Panel O1

Panel O1 is on the Fore Station desktop and indicates problems with the GPC by providing the feedback lights of the Computer Annunciation Matrix (CAM). The CAM lights indicate how the individual GPCs vote against each other when performing GPC status and redundancy checks. When a GPC registers a vote against another GPC, the corresponding lamp will illuminate. Along the diagonal, the lamps are yellow. On the off-diagonals, the lamps are white. Click the top right corner of the panel to close.

5.3.5 Panel O6

Panel O6 is on the Fore Station desktop and contains various switches for the DEUs, MDMs, and GPCs. In the orbiter cockpit, Panel O6 is located directly above the commander seat. Click the top right corner of the panel to close. Click the desired position of the switch to move up, down, or center.

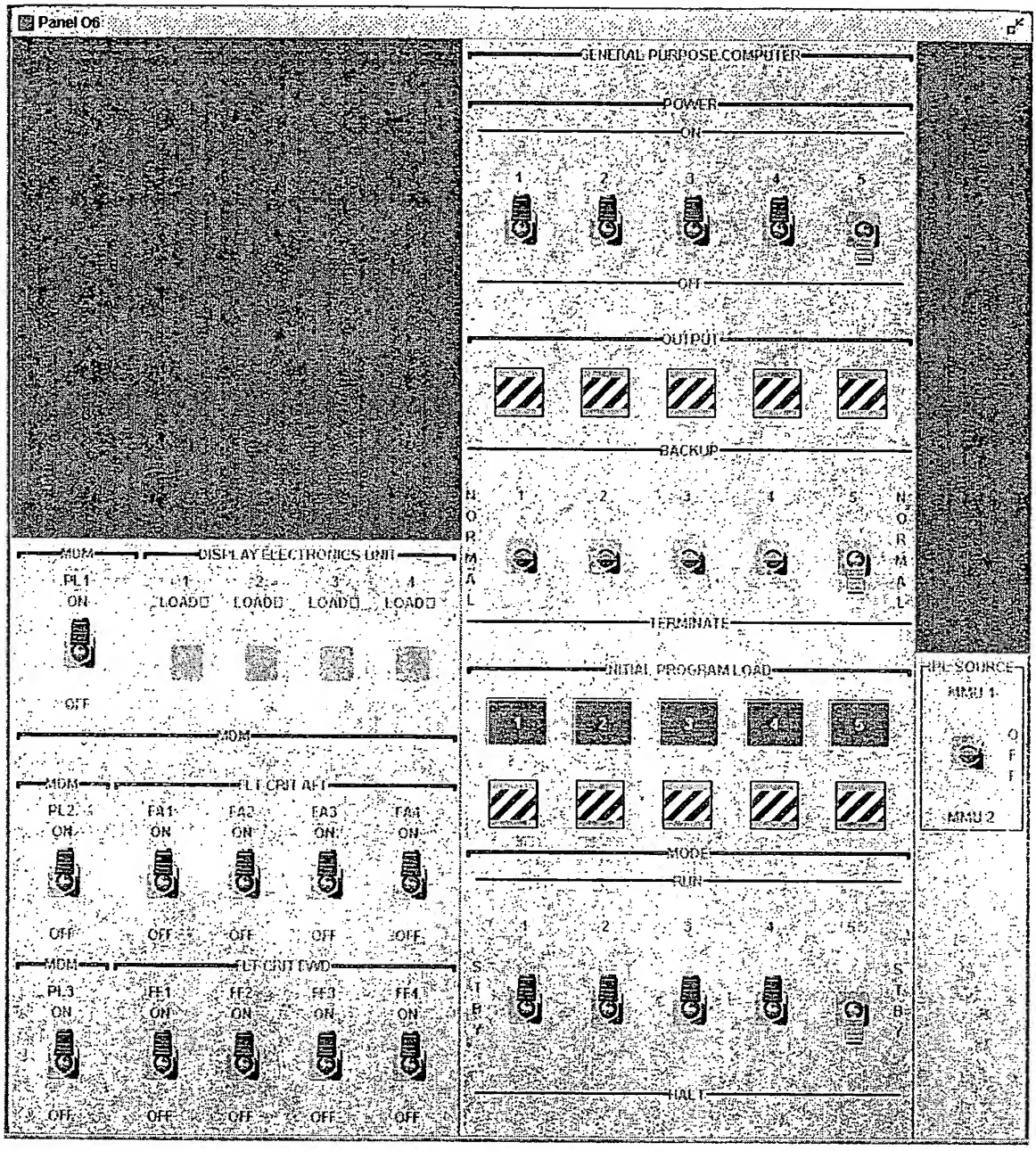

Figure 5-6. Panel O6

Table 5-9. Panel O6

Switch	Description
MDM	
MDM PL1	Specifies whether the MDM to PL1 is ON or OFF
DISPLAY ELECTRONICS UNIT	Momentary switches that set bits in the DEU status response buffer to make the GPC reload the DEU buffer; click below the switch to activate (load) an IPL for the corresponding CRT
MDM PL2	Specifies whether the MDM to PL2 is ON or OFF
FLT CRIT AFT	Specifies whether the FA power is ON or OFF to each MDM for the PL
MDM PL3	Specifies whether the MDM to PL3 is ON or OFF
FLT CRIT FWD	Specifies whether the FF power is ON or OFF to each MDM for the PL
POWER	
ON	Specifies whether the power is ON for each of the five GPCs
OFF	Specifies whether the power is OFF for each of the five GPCs
OUTPUT	
TALKBACKS	Gray – Output is being received from the corresponding GPC Barber Pole – Output is not being received from the corresponding GPC
BACKUP	Prevents the GPC from transmitting over the flight-critical data busses until the BFS is engaged
NORMAL	Allows the GPC to transmit over the flight-critical data busses
TERMINATE	Prevents the GPC from transmitting over the flight-critical data busses
INITIAL PROGRAM LOAD	Initiates the Initial Program Load (IPL) on the GPCE
MODE	
TALKBACKS	RUN – Indicates the GPC is processing PASS software or in STBY mode Barber Pole – Indicates the GPC is not processing PASS software
RUN	Enables the GPC to process PASS software and support normal GPC operation
STBY	(Standby) Indicates the GPC is ready to enter RUN mode
HALT	Indicates the GPC is not processing PASS software
IPL SOURCE	
MMU 1	Mass memory source for subsequent IPLs
MMU 2	Mass memory source for subsequent IPLs
OFF	No mass memory source for subsequent IPLs

5.4 AFT STATION

The Aft Station tab represents the displays and controls available to the flight crew at the aft of the flight deck. In the orbiter flight deck, this panel is located behind the pilot's seat. This tab includes one CRT (CRT 4), the Aft Keyboard, and one panel section related to these devices. You can resize CRT 4. You cannot resize the Keyboard or Panel.

5.4.1 Panel R12L

Panel R12L is on the Aft Station desktop and contains the power and MAJ FUNC (Major Function) selection for DEU 4 (CRT 4). Click the top right corner of the panel to close.

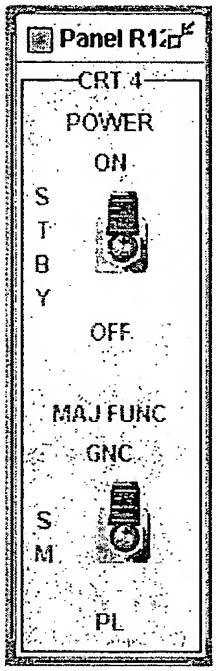

Figure 5-7. Panel R12L

Table 5-10. Panel R12L

Switch	Description
POWER	ON – Refreshes the CRT with the latest contents from the GPCE STBY – (Standby) CRT panel is blank and displays a fictional status word OFF – CRT panel goes blank and displays a fictional status word
MAJ FUNC	GNC – Sets DEU status buffer bits to enable flight software to send a different MAJ FUNC output to each DEU STBY – (Standby) CRT panel is blank and displays a fictional status word PL – Sets DEU status buffer bits, which enables the flight software to send a different MAJ FUNC output to each DEU

5.5 HISTORY

The History tab provides three panes of event lists that occur during an MCDS emulator run-time session and can be repositioned, resized, and minimized. You can resize the event list columns by dragging the divider between the columns, and you can reposition the columns within the list by dragging the column header left or right into the desired position. Each pane provides a chronological list of events. Frame contents cannot be edited. The MCDS emulator automatically updates the time tags when the event is generated. The column header shows the current style of time tag (e.g., DEU Time). The color of the list entries has built-in values, but by changing Java property values, you can change the foreground and background colors for certain classes of events.

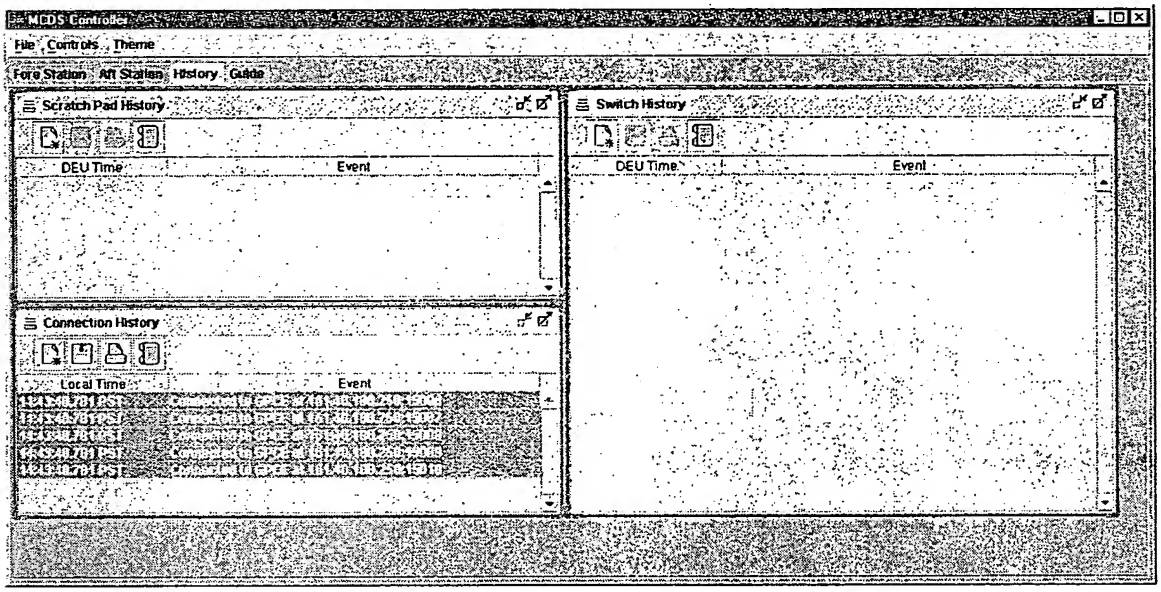

Figure 5-8. History

Table 5-11. Event History Toolbar

Tool		Description
Clear		Erases the contents of the event list; subsequent events will resume filling the list; this is an unrecoverable action
Save		Enables you to save the event list to a file with a user-specified name and will contain the event descriptions and time tags in ASCII format
Print		Prints the event list
Time-tag		Enables you to change the format of the time tags appearing in the event list

5.5.1 Connection History

The Connection History pane logs socket connection status events. These events include connection events, disconnection events, and socket error messages.

5.5.2 Scratch Pad History

The Scratch Pad History pane logs the CRT Scratch Pad Line entries made on any of the four CRTs. Entries are listed from earliest (top of list) to newest (bottom of list). Mistakes, backspaces, and work-in-progress are not logged. The MCDS emulator does not record fault messages in Scratch Pad History.

Note: To see the PASS software fault messages, type SPEC 99 PRO on any MCDS CRT or hit FAULT SUMM. Typing SPEC 99 PRO twice will clear the message log.

5.5.3 Switch History

The Switch History pane logs panel switch position changes. Each event in the Switch History log shows the new position description and the time the position change occurred. These events occur in two ways: when you change the position of one of the switches on the desktop switch panels, or when the program opens the socket connection with the GPCE.

5.6 KEYBOARDS

The Keyboard panels on the Fore Station and Aft Station desktops model the actual keypads used in the orbiter cockpit. The Keyboards allow you to provide instructions to the MCDS and GPC, which are displayed on the Scratch Pad Line. These instructions are created when you click Keyboard buttons (or instructions can be entered manually by hand). If you have enabled the Flashing mode, the first command sequence text will flash.

When you activate one of the Keyboard implement keys, the command is sent to the GPC as a POLL response. If the key sequence produces invalid syntax, the Scratch Pad Line displays the problem. The MCDS emulator will not transmit the command to the GPC.

Both the CDR and PLT Keyboards can be assigned to CRT 3 at the same time, but simultaneous input will conflict. If a Keyboard is assigned to an unpowered CRT, it is unpowered and inactive. To regain the Keyboard, move the CRT Select switch toward a powered CRT.

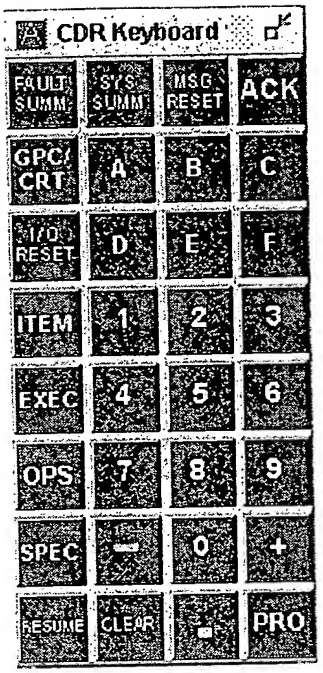

Figure 5-9. CDR Keyboard

Table 5-12. Keyboards

Key	Description
0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F	Provide values for ITEM, SPEC, OPS, and GPC/CRT key sequences
+	(Plus) Accompanies numeric entries to specify the sign or continue ITEM entry sequences
□	(Minus) Accompanies numeric entries to specify the sign or continue ITEM entry sequences
ACK	(Acknowledge) Stops the current message from flashing, but will leave the message displayed on the Message Line
CLEAR	Clears the last echoed keystroke from the CRT Scratch Pad Line. For each depression, one additional keystroke is removed, proceeding from right to left. After a command sequence is completed, a single depression of the clear key will erase the static command from the Scratch Pad Line.
EXEC	(Execute) Acts as a multi-keystroke initiator to command the execution of the action specified on the Scratch Pad Line. It terminates the initiators above it (GPC/CRT, I/O RESET, and ITEM keys).
FAULT SUMM	(Fault Summary) Calls up the fault summary message display (SPEC 99). To clear the contents of the fault summary message display, call up the display by entering its number: SPEC 99 PRO.
ITEM	Multi-keystroke command initiator for changing the value of defined parameters or implementing configuration changes on a given display (OPS or SPEC)
MSG RESET	(Message Reset) Acknowledges the top-most fault message on the Message Line. If there are subsequent messages queued below the current message, the DEU will ask the GPC to display the next message in the queue until all unacknowledged messages have been reset.

Key	Description
OPS	(Operations) Multi-keystroke initiator to load a desired operations from mass memory into one or more GPCs; used to proceed from major mode to major mode within an operation
PRO	(Proceed) Initiates the OPS and SPEC keys. The completed sequence initiates the selection of a desired OPS, SPEC, or DISP display.
I/O RESET	Resets the GPC input/output communications to the normal configuration when followed by EXEC
RESUME	Initiates a displayed SPEC or display; CRT control is restored to the underlying display
SPEC	(Specialist Function/Display Function) Multi-keystroke initiator to select a defined SPEC or DISP display within a given OPS. In addition, this key provides the capability to freeze a display on the CRT. A single depression of the SPEC key freezes the display so it may be statically viewed. The display will remain frozen until another key (other than ACK, MSG RESET, or another SPEC) is entered.
SYS SUMM	(System Summary) Major function dependent. In the GNC major function, this key will call up GNC SYS SUMM 1 (also recalled by SPEC 18 PRO) or GNC SYS SUMM 2 (also recalled by SPEC 19 PRO). In the SM major function, this key will call up SM SYS SUMM 1 (also recalled by SPEC 78 PRO) or SM SYS SUMM 2 (also recalled by SPEC 79 PRO). Depressing this key consecutively toggles between the two displays.

5.7 RUN-TIME PROPERTIES

Run-time properties allow you to set new property defaults for the MCDS emulator. The `controlgui.properties` file provides user-level, application-specific properties. Residing in the original local directory, the program reads the defaults file first, then overlays the application property values over the defaults. This way, the application properties supersede the defaults. Upon normal termination, the program will save the values of the reconfigurable properties to the application properties file during run-time. When the program is restarted, it will contain the new values.

6.0 USING THE MCDS EMULATOR

1. Start the GPCE.
2. On the PTPC desktop, double-click the MCDS emulator icon to start the MCDS emulator.
3. In the Controls menu, click Socket.
4. In the Connection Manager Host Name field, type the IP address of the OIAB.
5. In the Port Number field, type 15006.
6. Click Connect. DK1, DK2, DK3, and DK4 will turn green.
7. Click Dismiss to close the Connection Manager.

6.1 ACTIVATING GPC1

1. In the MCDS emulator desktop, click Fore Station Panel O6.
2. In the Mode section, set GPC 1 to HALT (down).
3. In the Mode section, set GPC 1 to RUN (up).
4. The CRT displays will update, and the GPC 1 IPL will indicate RUN.

6.2 ACTIVATING GPC 4

1. In the MCDS emulator desktop, click Fore Station Panel O6.
2. In the Mode section, set GPC 4 to HALT (down).
3. In the Mode section, set GPC 4 to RUN (up).
4. The CRT displays will update, and the GPC 4 IPL will indicate RUN.

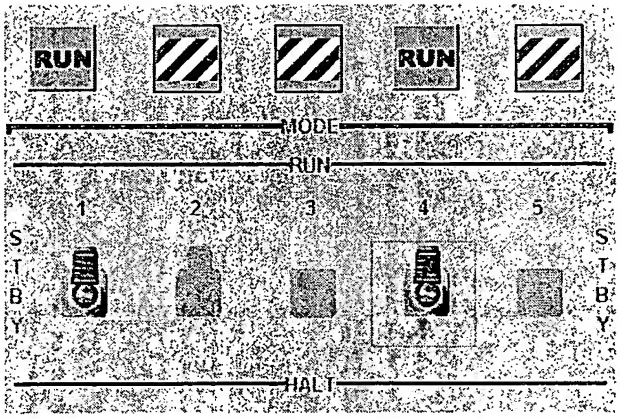

Figure 6-1. Section of Panel O6 Showing RUN

6.3 CONFIGURING GPC1 IN GNC OPS 201

1. In the MCDS emulator desktop, click Fore Station Panel C2.
2. In the CRT 1 section, set the MAJ FUNC to GNC (up).
3. On the CDR Keyboard panel, click the following sequence to change the string configuration:

   ITEM → 1 → + → 2 → EXEC

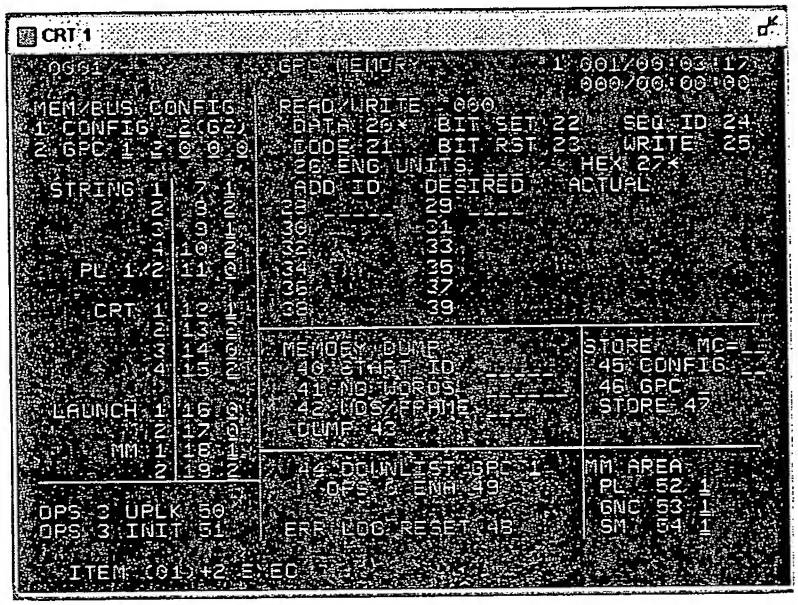

Figure 6-2. ITEM 1 + 2 EXEC

4. On the CDR Keyboard panel, click the following sequence to change the OPS configuration:

   OPS → 2 → 0 → 1 → PRO

6.4 CONFIGURING GPC4 IN SM OPS 201

To configure GPC4, you must configure a CRT to take inputs for GPC4.

1. In the MCDS emulator desktop, click Fore Station Panel C2.
2. In the CRT 2 section, set the MAJ FUNC to SM (middle).
3. In the PLT Keyboard, click the following sequence:

   GPC/CRT → 4 → 2 → EXEC

4. In the PLT Keyboard, click the following sequence:

   ITEM → 1 → + → 4 → EXEC

5. In the PLT Keyboard, click the following sequence:

   OPS → 2 → 0 → 1 → PRO

6.5 CARGO PC SPEC PAGES

There are three Specialist Function (SPEC) displays used to control and monitor payloads controlled by the Cargo PC. These displays are SPEC 71, SPEC 72, and SPEC 73. The displays are populated with payload information from the CDT's Payload Application Definition section under Services.

6.5.1 SPEC 71

SPEC 71 shows the command and telemetry status of SPEC 72 and SPEC 73. By executing SPEC 71, you upload payload command and data tables to the Cargo PC to start communication between the Cargo PC and a GPCF on Port 1.

1. In the PLT Keyboard, click the following sequence:

   SPEC → 7 → 1 → PRO

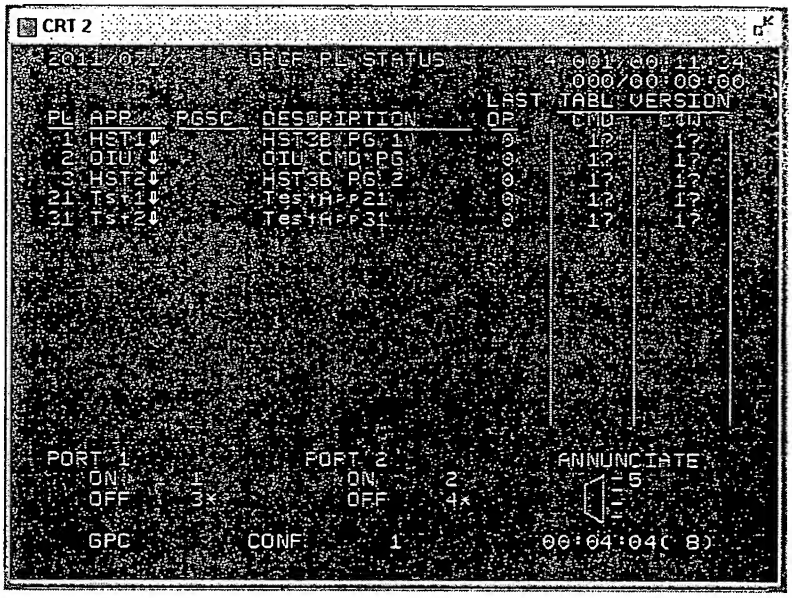

Figure 6-3. SPEC 71

2. In the PLT Keyboard, click the following sequence:

   ITEM → 1 → EXEC

6.5.2 SPEC 72

SPEC 72 displays the payload commands, allowing you to view a payload application command list, monitor the command execution via the Cargo PC, and/or execute a payload command.

1. In the PLT Keyboard, click the following sequence:

   SPEC → 7 → 2 → PRO

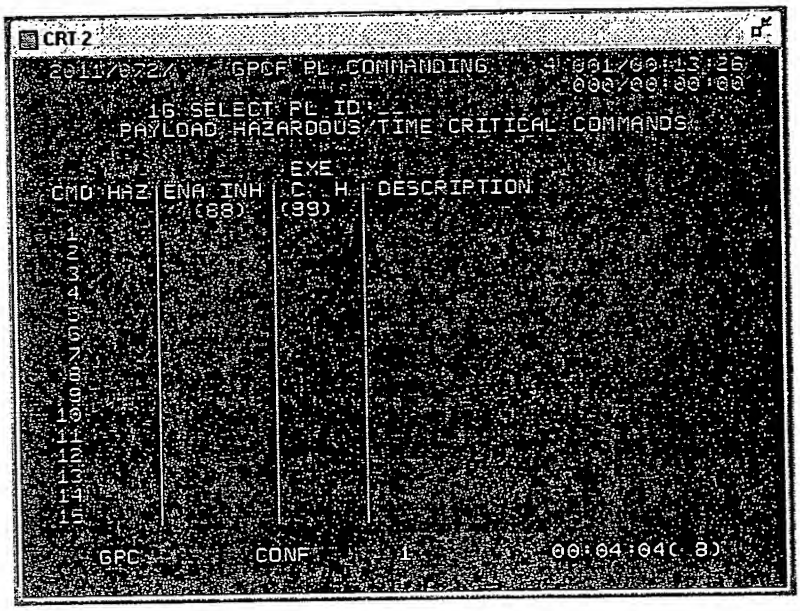

Figure 6-4. SPEC 72

2. To display an application's commands, in the PLT Keyboard, click the following sequence:

   ITEM → 1 → 6 → + → 1 → EXEC

3. To enable a command to be executed, in the PLT Keyboard, click the following sequence:

   ITEM → 3 → + → 8 → 8 → EXEC

4. To execute a command, in the PLT Keyboard, click the following sequence:

   ITEM → <command number> → + → 9 → 9 → EXEC

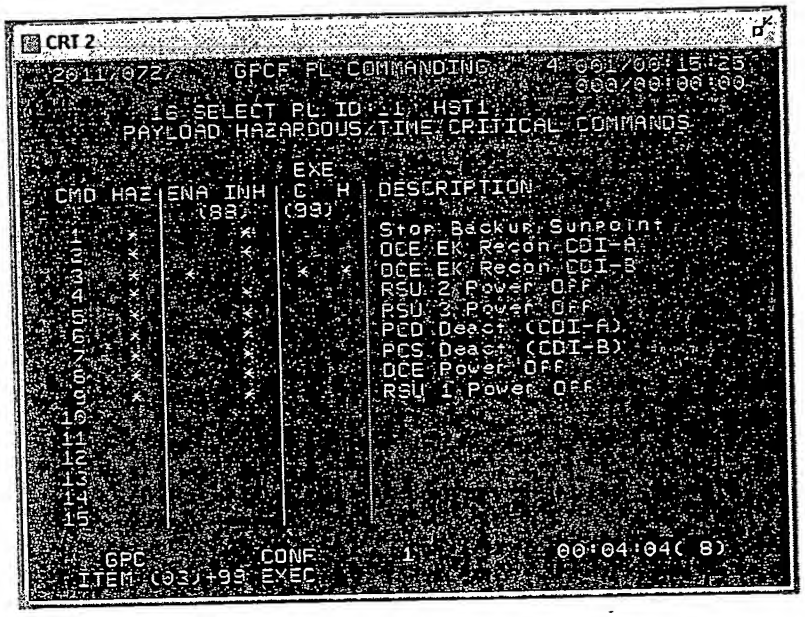

Figure 6-5. Executing a Command in SPEC 72

6.5.3 SPEC 73

SPEC 73 allows you to view data (telemetry) from up to two payload applications. It also displays the Caution & Warning (C&W) messages.

1. In the PLT Keyboard, click the following sequence:

   SPEC → 7 → 3 → PRO

2. To display payload application data, in the PLT Keyboard, click the following sequence:

   ITEM → 1 → + → <payload application data> → EXEC

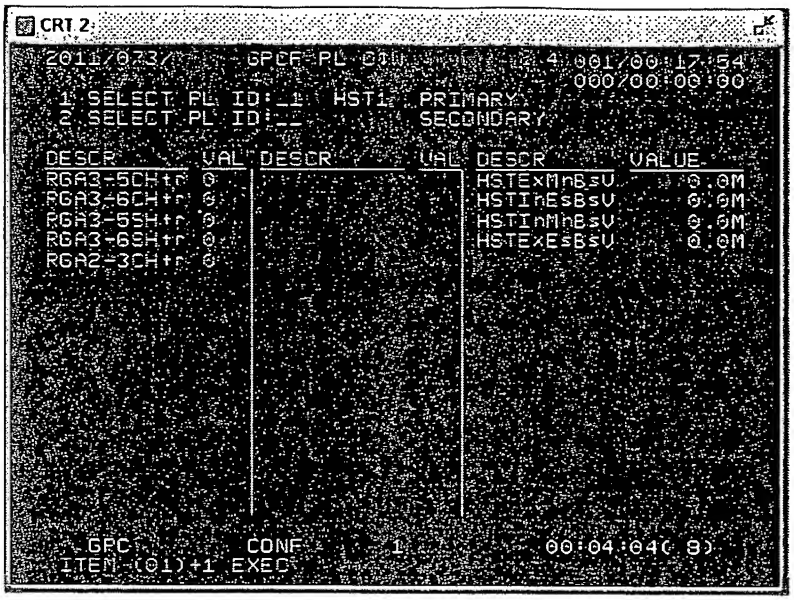

Figure 6-6. SPEC 73

6.6 TELEMETRY SPEC PAGES

6.6.1 SPEC 62

SPEC 62 allows you to enable a PSP, load the PCMMU with a telemetry format (TFL), and load the PDI with a payload telemetry format (DFL).

6.6.1.1 Enabling a PSP/Loading the PCMMU with Telemetry Format

1. In the MCDS emulator's PLT Keyboard on the Fore Station, click the following sequence:

   SPEC → 6 → 2 → PRO

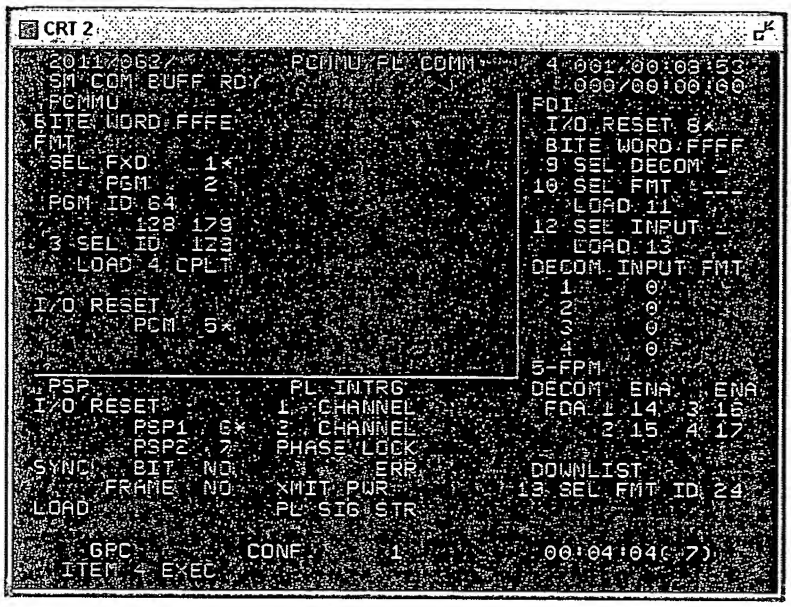

Figure 6-7. SPEC 62

2. To enable PSP1, in the PLT Keyboard, click the following sequence:

   ITEM → 6 → EXEC

   Note: OIAB only supports one PSP. Always enable PSP1.

3. To load the PCMMU with TFL 179, in the PLT Keyboard, click the following sequences:

   ITEM → 3 → + → 1 → 7 → 9 → EXEC
   ITEM → 4 → EXEC

4. Wait for Item 4 CPLT to appear before continuing.

5. In the PLT Keyboard, click the following sequence:

   ITEM → 2 → EXEC

6.6.1.2 Loading the PDI Format with Telemetry Format

6.6.1.2.1 Fault Detection Annunciation (FDA) Messages for Decom 1

1. In the PLT Keyboard, click the following sequence:

   SPEC → 6 → 2 → PRO

2. In the PLT Keyboard, click the following sequence:

   ITEM → 1 → 4 → EXEC

6.6.1.2.2 Process Load the Decom 1 Command

1. In the PLT Keyboard, click the following sequence:

   SPEC → 6 → 2 → PRO

2. In the PLT Keyboard, click the following sequences:

   ITEM → 9 → + → 1 → EXEC
   ITEM → 1 → 0 → + → 9 → EXEC
   ITEM → 1 → 1 → EXEC

6.6.1.2.3 Process Load the Switch Matrix Command for Port 1

1. In the PLT Keyboard, click the following sequence:

   SPEC → 6 → 2 → PRO

2. In the PLT Keyboard, click the following sequences:

   ITEM → 1 → 2 → + → 1 → EXEC
   ITEM → 1 → 3 → EXEC

6.6.1.2.4 Execute Load the Fetch Pointer Memory Command

1. In the PLT Keyboard, click the following sequence:

   SPEC → 6 → 2 → PRO

2. In the PLT Keyboard, click the following sequences:

   ITEM → 9 → + → 5 → EXEC
   ITEM → 1 → 0 → + → 5 → 0 → 1 → EXEC
   ITEM → 1 → 1 → EXEC

6.7 SPEC 99

The flight software provides the fault message log on the FAULT SUMM display on SPEC 99.

1. In the PLT Keyboard, click the following sequence:

   SPEC → 9 → 9 → PRO

7.0 ACRONYMS AND ABBREVIATIONS

AID	Analog Input Differential
BFC	Backup Flight Controller
BTU	Bus Terminal Unit
C	Console
C&W	Caution & Warning
CAM	Computer Annunciation Matrix
CDR	Commander
CRT	Cathode Ray Tube
DEU	Display Electronics Units
DFL	Decom Format Load
DIH	Discrete Input High
DIL	Discrete Input Low
DIP	Dual Inline Package
DOH	Discrete Output High
F	Forward
GNC	Guidance and Navigation Computer
GPC	General Purpose Computer
GPCE	General Purpose Computer Emulator
GPCF	GPC Payload Command Filter
ID	Identification
IP	Internet Protocol
ISP	Information Sharing Protocol
LAN	Local Area Network
LED	Light Emitting Diode
MCDS	Multifunction CRT Display System
MDM	Multiplexer/Demultiplexer
MIC	MDM Serial Interface Card
MSID	Measurement Stimulus ID
O	Overhead
OIAB	Orbiter-In-A-Box
PASS	Primary Avionics Software System
PC	Personal Computer
PCMCIA	Personal Computer Memory Card International Association
PCMMU	Pulse Code Modulation Master Unit
PDI	Payload Data Interleaver
PDIP	Payload Data Interface Panel
PLT	Pilot

PnP	Plug and Play
POST	Payload Operations Support Team
PSP	Payload Signal Processor
PTPC	POST Tools PC
RAM	Random Access Memory
SBC	Single Board Computer
SCRAMnet	Shared Common Random Access Memory Network
SCSI	Small Computer System Interface
SIO	Serial Input/Output
SIP	Standard Input Panel
SM	System Management
SMCH	Standard Mixed-Cargo Harness
SMS	Shuttle Mission Simulator
SMT	SMS Modeling Tool
SFOC	Space Flight Operations Contract
SSP	Standard Switch Panel
TCP	Transmission Control Protocol
USA	United Space Alliance

8.0 GLOSSARY

8.1 CONNECTORS

This term refers to the physical modules (or ports) connecting two devices, in particular the connection between the payload and OIAB or the connection between the Cargo PC and the OIAB. The connector is either on the device or at the end of a cable connected to the device.

8.2 DATASTORE

A datastore is similar to a checkpoint, except that a datastore refers to the simulation model state. The OIAB can recover the model and flight software state from a datastore.

8.3 ETHERNET SWITCH

The OIAB development system enclosure contains a six-port, 10/100 Base TX Ethernet switch. This switch provides a way to switch traffic from external systems and the two embedded processor boards without requiring an external switch. This is of interest primarily in standalone applications.

8.4 ISP SERVER

The OIAB system software includes an ISP server. This server acquires real-time data from the SMS model data pool and the PCMMU model. ISP client applications (elsewhere on the network) can request "telemetry" from this server to drive MCC-style displays and computations.

8.5 MCDS

On-board the orbiter, this refers to the CRT displays, keyboards, and processors attached to the flight computers through the DEU and display-keyboard busses. This provides the crew's user-interface to the PASS. In the OIAB context, the MCDS refers to a Java-language software package that provides emulation of the DEU and simulation of the keyboards, CRTs and relevant panel switches. The emulation of the DEU refers to the program's ability to encode and decode DEU instructions for rendering displays or processing keyboard input. The MCDS emulator provides the user interface to the PASS running on the GPCE inside the OIAB. Because it is written in Java, the MCDS program can run anywhere on the network.

8.6 MDM

A multiplexer converts parallel input into one serial output. A demultiplexer converts serial input into parallel output. An orbiter MDM is a black box that performs both functions, enabling a device on the serial I/O side (such as a GPC or PCMMU) to communicate with many sensors and effectors on the parallel I/O side. There are many types and instances of MDMs on the orbiter. Those of

primary interest to POST are the Payload MDMs (there are two of these, PF1 and PF2), which contain a card that communicates with serial I/O devices. The Cargo PC will have a specially designed PCMCIA card that connects to this serial I/O card within the Payload MDM: this path enables the Cargo PC to communicate with the GPCs. Specifically, this communication path enables the Cargo PC system software to send and receive messages with the GPCF application running in the PASS. To support the customer's development of the Cargo PC software, the OIAB provides a similar serial channel interface. The OIAB side of the interface uses a complementary specially designed PCMCIA card called the MIC.

8.7 MIC

This is a specially designed PCMCIA card that enables the Cargo PC to communicate with the orbiter payload MDM serial interface. The MIC plugs into the Cargo PC. A cable connects the MIC with a serial I/O port in the crew compartment. The OIAB uses a unique version of the MIC for its side of the connection. The difference between the Cargo PC MIC and the OIAB MIC is that the latter is able to act as bus commander of the serial interface. When used with the OIAB, a cable connects the Cargo PC MIC directly with OIAB MIC.

8.8 PANEL SWITCHES

The MCDS provides a graphical simulation of certain orbiter cockpit panels. The MCDS provides the portions of panels containing switches relevant to MCDS and GPCE control, such as panels C2, O6, and R12L. The MCDS user controls the position of the switches using the mouse.

8.9 PCM

Pulse Code Modulation. PCM is a standard communications technique for telemetry and other applications. For OIAB, the communication link from the PCMMU to the Cargo PC and the communication link from the attached payload to the PDI are in PCM format. The communication contents vary according to predefined data formats.

8.10 PCMMU

The orbiter's PCMMU collects telemetry from three sources and creates a consolidated telemetry output stream for the network signal processor (NSP). The PCMMU collects downlist telemetry from the GPC's, payload telemetry from the PDI, and operational instrumentation (OI) telemetry from the OI MDM's. In the OIAB context, the PCMMU is a telemetry card that creates data for (a) output to the Cargo PC, and (b) output to the ISP server, which serves as the ground site telemetry distribution server.

8.11 PDI

The orbiter's PDI collects data input directly from the attached payloads and indirectly from the detached payloads (via the PSP). It multiplexes this input into a payload telemetry stream for the PCMMU. In the OIAB context, the PDI is a telemetry card that receives telemetry data from the attached payload (or test equipment).

8.12 PSP

The orbiter's PSP receives telemetry from detached payloads (via the payload interrogator) and forwards it to the PDI, and it receives commands from payload MDM's and forwards them either to the attached payloads (via the payload patch panel) or the detached payloads (via the payload interrogator). In the OIAB sense, the PSP is a telemetry card that forwards commands from the payload MDM model to the attached payload (or test equipment).

8.13 SCRAMNET

This term refers to a Systran Inc. product for implementing a network-based reflective memory service between real-time computer systems. In the OIAB tool context, the SCRAMNet VMEbus card provides the high-speed memory access necessary to support the payload training models running on the PTPC. The PTPC also has a SCRAMNet product, though the PC version is a PCI bus card.

8.14 SIO

The communication protocol between the Cargo PC and the payload MDM.

8.15 SIP

An SIP is located on each side of the cargo bay to provide interfaces for the Standard Mixed-Cargo Harness (SMCH), add-on black boxes, unique connector panels, structural support and clamps for cables and the payload active cooling kit. The OIAB does not provide a SIP for development and testing.

8.16 SSP

These panels on the orbiter's aft flight desk are part of the crew's standard payload display and control interfaces. Each SSP can manage up to four payloads per mission, depending on payload requirements.

8.17 SMS MODELS

The OIAB application software includes a complete set of the SMS vehicle and environment models. These models previously were integrated with the GPCE, MDM models, PCMMU model, and ISP server during the next-generation flight controller trainer development project. The OIAB supports this integrated model set in order to (a) generate simulated orbiter subsystem data streams for output

to the Cargo PC, (b) test the integration of the customer's payload training model, and (c) generate a complete telemetry stream for an ISP server to test ground support client applications.

8.18 WEB SERVER

The OIAB processor system software includes an embedded web (hypertext transfer protocol) server in the form of the WindWeb™ product. This enables network users with web browsers to post requests to the web server for system software control, debug information, and status updates.